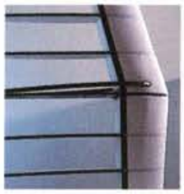
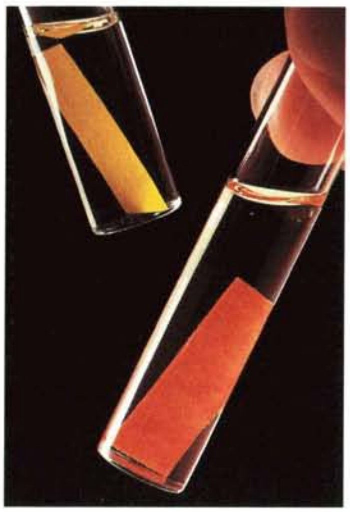
Water Sensors



Michael J. Morris, president of pHish Doctor, Inc. and Ocean Optics, Inc., Dunedin, Florida is an inventor formerly employed by the Southern Technology Application Center (STAC) at the University of South Florida in Tampa.

STAC is a NASA-sponsored industry assistance center operating a special Services for Inventors Network that provides technical and marketing help for product innovators.



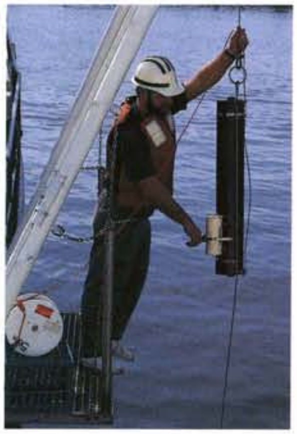
In 1986, Morris had an idea for a novel product — a pH monitor for home aquariums. The pH factor is an indication of the acidity or alkalinity level of a solution. Morris developed immobilized dyes that offer a way of measuring the pH level, a technique somewhat analogous to the familiar litmus test, in which a treated paper changes color when exposed to acidity or alkalinity.

Morris, then associate director of STAC, became his own client and asked STAC for assistance in measuring the market potential of the invention, which he called the pHish Doctor. STAC conducted the necessary market research and reported that the outlook was positive. Morris then formed pHish Doctor, Inc. to develop a product for freshwater aquariums. He subsequently used STAC's service for technological guidance, business planning, funding opportunities, and manufacturing/distribution information.

The pHish Doctor consists of an arc-shaped sensor strip and a seashell-shaped color chart. Mounted in an aquarium with a suction cup (**below**), the sensor continually measures pH levels in the water and changes color as the pH factor changes; by comparing the color of the sensor strip with the color chart, the aquarium owner gets an instant pH reading. The photo **at left** shows the different color swatches of a sensor that has been exposed to three distinct levels of pH.

The reading is important. A changing pH level is an indication of trouble. When the level gets too high, the ammonia that fish excrete becomes highly toxic; at low pH, there is a danger that the bacteria that normally break down waste products in water will stop functioning. The continually monitoring pHish Doctor eliminates the need for periodic sample testing.

A designer-aquarium sales company, GM Aquatics, Fort Worth, Texas now handles manufacturing and marketing of the pHish Doctor, whose sales have run into the tens of



thousands and are still expanding. Morris still supplies the sensor strips himself and keeps secret how they are made.

The success of the pHish Doctor prompted Mike Morris to shift his focus toward pH detection in seawater. Salt water aquariums have a different pH range than freshwater tanks, so a different dye was needed. NASA technology provided a clue.

In *NASA Tech Briefs*, a monthly publication that describes new NASA technology available for transfer, Morris read of research on an immobilized enzyme used in a colorimeter test for alcohol. A follow-up information package supplied by NASA led him to try alternative strategies that resulted in a salt water version of the pH Doctor and development of several viable immobilization techniques that could be used with dyes.

This shift of focus was instrumental in the formation of Ocean Optics, Inc. to pursue technology for sensing pH in seawater. Ocean Optics won Phase I (feasibility determination) and Phase II (application) Small Business Innovation Research grants from the Department of Energy (DoE) for development of a pH sensor that will operate unattended on sea buoys for long periods and collect continuous data on how much carbon dioxide the ocean is absorbing from burning of fossil fuels.

Knowing the rate of oceanic carbon dioxide flux is critical to researchers studying the "greenhouse effect" of carbon dioxide buildup. Satellite ocean color measurements provide basic data; DoE wants the pH data to provide corroborating "sea truth" information. Ocean Optics is developing a fiber optic sensor employing the company's proprietary process that produces tough, thin, transparent coatings of pH indicator dyes. Optical transmission provides highly accurate pH readings, independent of pathlength, dye concentration and sensor-to-sensor variation

There are a number of commercial applications for the fiber optic sensor, such as pH meters for process control, general laboratory work, or implantable sensors for blood gas monitoring.

At left, Mike Morris is preparing to deploy a sea buoy for testing in the Gulf of Mexico. Ocean Optics' fiberoptic sensor is housed in the small white tube at the bottom of the buoy. The sensor itself is shown **below**; a laboratory technician is testing it with a color dye.

The newest evolution of Ocean Optics' technology is shown in the **bottom** photo. It is a miniature spectrometer to be used in conjunction with the fiber optic sensor. Measured in inches and weighing less than a pound, it is designed for use in many situations inaccessible to a normal spectrometer, typically an instrument weighing 60-150 pounds.